Association of Marital Status with the Incidence of Suicide

博士論文

Association of Marital Status with the Incidence of Suicide

（婚姻状況と自殺リスクに関する研究）

東北大学大学院医学系研究科　医科学専攻

社会医学講座　公衆衛生学分野

福地　成

Contents

1. Abstract Page 3-4

2. Introduction Page 5-8

3. Methods Page 9-14

4. Results Page 15-18

5. Discussion Page 19-28

6. Acknowledgment Page 29

7. References Page 30-35

8. Tables Page 36-39

1. Abstract

Background: Marital status is one of the most frequently replicated predictors of suicide. The purpose of this study was to examine the effect of marital status on the risk of suicide by gender, using a large population-based cohort in Japan.

Methods: The Miyagi cohort study was a population-based, prospective cohort study of Japanese adults aged between 40 and 64 years. Between June and August 1990, 47,604 participants resident in 14 municipalities of Miyagi Prefecture, Japan, completed a questionnaire on various health-related lifestyles, including marital status. During 18 years of follow-up, 146 of the participants committed suicide. We used the Cox proportional hazards regression model to estimate the hazard ratios (HRs) and 95% confidence intervals (95% CIs) for suicide mortality according to marital status with adjustment for potential confounders.

Results: A total of 106 and 40 deaths from suicide were recorded during 344,813 and 365,524 person-years of follow-up among 20,671 men and 21,076 women,

respectively. We found that marital status was significantly associated with the risk of completing suicide only in men. Among men, after multivariate adjustment, HRs in reference to married were: widowed or divorced, 2.86 (95% CI: 1.43-5.70); unmarried, 1.57 (95% CI: 0.67-3.64). A significantly increased risk of suicidal death was observed among widowed or divorced men, whereas no such trend was evident for women.

Conclusions: Our results suggest that men who are widowed or divorced, or unmarried, are at increased risk of suicide, whereas no such risk is evident for women.

2. Introduction

Every year, one million people die through suicide, the global suicide mortality rate being 16 per 100,000 people[1]. Over the last 45 years, the rate of suicide has gradually increased by 60% worldwide[1]. In Japan, 75% of the total suicide death is occupied by 40s to 60s years old people, on the contrary, suicide is one of the major causes of death in 20s to 40s. The annual number of suicides has continued to increase; in 2011 there were 30,651 suicide deaths (23.9 per 100,000 people)[2]. The World Health Organization has reported that the suicide mortality rate in Japan is higher than in any other developed country (France, 16.3 per 100,000 in 2007; Germany, 12.3 per 100,000 in 2010; Canada, 11.3 per 100,000 in 2004; USA, 11.5 per 100,000 in 2005; UK, 6.9 per 100,000 in 2009; Italy, 6.5 per 100,000 in 2008)[3]. It has been emphasized that the Asian Financial Crisis of 1997-1998 had a great impact on the economy of Japan, leading to a sharp rise in the suicide rate. Since then, the suicide rate has not improved, even after the macroeconomic recovery, and the annual number of suicide deaths

has remained at approximately 30,000 since 1998[4]. In order to develop effective strategies for suicide prevention in Japan, there is an urgent need to investigate the factors associated with an increased risk of suicide.

Previous studies have identified, various sociodemographic and clinical variables as risk factors of suicide, and among these factors gender, marital status and living arrangements appear to be the most important factors[5]. So far, six studies have examined the association between marital status and suicide risk, using a population-based study design (Table 1)[6)-11)]. All of these studies found that individuals who were widowed, divorced, or living alone were at higher risk of suicide[6)-11)]. Two of these studies revealed that individuals who lived alone had a higher suicide risk than individuals who lived with someone[7), 10)], and one of these two studies showed that men were more likely to complete suicide than women living under the same the conditions[7)].

In Japan, there has been a gradual change in family structure, with a shift toward nuclear families consisting of only parents and children[2)]. At the same

time, there has been a tendency for the marriage rate to decrease gradually, together with an increase in the divorce rate. National figures for Japan have shown an increase in the divorce rate from 1.22% to 1.99% and a decrease in the marriage rate from 6.7% to 5.5%, resulting in an increase in the number of people who are living alone from 19.8% to 32.4% between 1980 and 2010[2)]. In 2010, the proportion of elderly people more than 60 years old living alone accounted for 11.9% of men and 18.3% of women[12)]. These data indicate that the proportion of individuals who are widowed, divorced, or unmarried is increasing, and it seems that this trend will continue in the future. Living alone is associated with a high risk of social isolation, and this in turn may lead to suicide.

A study conducted in Japan to investigate the association between marital status and suicide found that among 15,597 individuals over a 14-year periods, 48 suicide deaths (29 men and 19 women) occurred[9)]. Among the study subjects, men who were living alone, widowed or divorced had a higher risk of suicide than women living under the same conditions. The multivariate relative risk (RR) for

living alone was 4.7 (95% CI: 1.4-15.9) among men, whereas that for widowed or divorced men was 2.9 (95% CI: 0.9-10.0). However, this previous study did not have a large sample size and did not control for potential confounding factors, such as alcohol consumption, smoking status, education level, and job status. Therefore, we tried to examine the association between marital status and the risk of completing suicide in a large population-based cohort study in Japan which has the highest suicidal rate. More specifically, we investigated whether differences in marital status, such as being widowed, divorced, or unmarried, had an impact on suicide risk.

3. Methods

2-1. Study Population and Design

This study was based on a prospective cohort study conducted in Miyagi Prefecture, northeastern Japan, details of which have been reported previously[13]. In brief, between June and August 1990, we delivered a self-administered questionnaire on various health habits to all residents aged 40-64 years (n=51,921 comprising 25,279 men and 26,642 women) living in 14 municipalities of Miyagi Prefecture. The questionnaires were delivered to and collected from individuals' residences by each municipal government, and 47,604 of them were confirmed to be eligible as participants (response rate: 91.7%; 22,835 men and 24,769 women). Because all residents in the study area had been entered as cohort subjects and because the rate of response to the questionnaires was very high, we considered our subjects to be sufficiently representative of the area. The study protocol was approved by the institutional review board of Tohoku University School of Medicine. We also considered that the return of administered questionnaires

signed by the participants implied their consent to participate in the study.

For the present analysis, we excluded individuals who had entered incomplete responses for marital status (n=5,857, comprising 2,164 men and 3,693 women), and also eliminated one participant who had moved from the study area when we started the prospective data collection. With these exceptions, 41,747 participants (20,671 men and 21,076 women) remained eligible for our analysis.

2-2. Exposure Assessment

Baseline data for all participants were collected using a questionnaire that included items inquiring about marital status, consumption of alcohol and tobacco, body weight and height, job status, level of education, time spent walking per day, self-reported stress, sleep duration, and medical history. With regard to current marital status, each participant was asked "What is your marital status?" The response choices were "married", "widowed or divorced", and "unmarried."

2-3. Follow-up and Identification of Suicide

In order to follow up the participants for mortality and migration, we established a Follow-up Committee[14], which consisted of the Miyagi Cancer Society, the Community Health Divisions of all 14 municipalities, the Department of Health and Welfare of Miyagi Prefectural Government, the Division of Epidemiology, and Tohoku University Graduate School of Medicine. The Committee periodically reviewed the Residential Registration Record of each municipality. Through this review, we identified participants who had either died or emigrated during the follow-up period and discontinued follow-up of those who had emigrated from the study area because the Committee were unable to review the Residential Registration Record outside the study area.

For decedents, we investigated the causes of death by reviewing the death certificates with permission from the Ministry of Health, Labour and Welfare, Japan. The end point was suicide mortality. The cause of death was classified according to the International Classification of Diseases (ICD), 9th revision, between June 1 1990 and December 31 1998[15], and 10th revision, between

January 1 1999 and December 31 2008[16]. Death by suicide was identified as ICD-9: E950-E959, or ICD-10: X60-X84.

Because of the fact that registration of deaths is required under the Family Registration Law and that death certificates must be completed by a licensed physician in Japan, death certificates confirmed all deaths that occurred in the study area. The verdict of suicide is based on the results of the medico-legal examination by a licensed physician and police examination as required by Japanese law. Thus, the data are considered to be reliable in terms of quality and completeness.

2-4. Statistical Analyses

We calculated the person-years of follow-up for each participant from beginning of the follow-up until the date of death, the date of emigration from the study districts, or the end of the follow-up period, whichever occurred first. We performed the Cox proportional hazard regression analysis to estimate the hazard ratios (HRs) and 95% confidence intervals (95% CIs) for suicide incidence

according to marital status as the reference group, after adjustment for potential confounders. All statistical analyses were performed using the SAS statistical software package, version9.3 (SAS Institute, Inc., Cary, NC, USA).

We considered the following variables to be potential confounders: age in years (continuous variable), alcohol consumption (never drank alcohol, drank in the past, or currently drinking consuming <45.6g alcohol/day, currently drinking consuming ≧45.6g alcohol/day), smoking status (never smoked, smoked in the past, currently smoking less than 20 cigarettes per day, or 20 cigarettes per day or more), body mass index (BMI) in kg/m^2 (continuous variable), job status (employed or unemployed), education level (high school or less, or college/university or higher), time spent walking (less than 1 hour per day, or 1 hour per day or more), self-reported stress (high, average, or low), sleep duration (less than 7 hours per day, or 7 hours per day or more), history of stroke, hypertension, myocardial infarction, diabetes mellitus, or cancer (presence or absence), and total calorie intake (continuous variables).

In addition, we repeated the analyses after excluding all deaths that occurred within the first three years of follow-up because subjects who died during this period might have been in poor health at the baseline. Interactions between marital status and all confounders were tested through the addition of cross-product terms to the model.

4. Results

The 41,747 participants included 20,671 men and 21,076 women. Mean age was 51.6 years (SD=7.64) for men and 52.1 years (SD=7.47) for women. Among men during 344,813 person-years of follow-up, 106 deaths due to suicide were detected, whereas among women during 365,524 person-years of follow-up, 40 deaths due to suicide were recorded. We examined marital status in relation to suicide risk factors at the baseline among men and women separately.

Table 2 compares the baseline characteristics of the participants according to marital status and gender. Among men, 92.5% were married, 3.7% were widowed or divorced, and 3.7% were unmarried. Those who were widowed or divorced tended to be aged, current smokers, and had a lower education level, a shorter sleep duration, and hypertension. Those who were unmarried men tended to be never drinkers, never smokers, and to be unemployed. Among women, 87.2% were married, 10.3% were widowed or divorced, and 2.5% were unmarried. Those who were widowed or divorced tended to be current drinkers,

and to have a lower education level and hypertension. Those who were unmarried tended to be employed, and to have a higher education level and a longer sleep duration. In both genders, individuals who were married tended to have a much higher daily total caloric intake than those who were widowed or divorced. In terms of body mass index, there were no large differences among the three categories of marital status; there were also no considerable differences in history of major diseases, except for hypertension.

Table 3 shows the association between marital status and the risk of suicide by gender. Among men, we found that those who were widowed or divorced tended to have higher suicide risks than those who were married. We initially calculated HRs for suicide risk with no adjustment at the baseline in model 1, and adjusted for only age at the baseline in model 2. We further adjusted for smoking status, alcohol consumption, body mass index, employment status, education, time spent walking, self-reported stress, sleep duration, and history of any chronic disease in model 3. In men, the unadjusted analysis

(model 1) showed that the HRs in reference to married were 2.67 (95% CI: 1.35-5.29) for being widowed or divorced and 1.67 (95% CI: 0.73-3.82) for being unmarried. This finding remained basically unchanged even after adjustment for model 2 and model 3. The multivariate adjusted analysis (model 3) showed that the HRs in reference to married was 2.86 (95% CI: 1.43-5.70) for being widowed or divorced and 1.57 (95% CI: 0.67-3.64) for being unmarried. In model 4, the findings remained basically unchanged even after exclusion of deaths that occurred within the first three years of follow-up. However, the results for women were different because the multivariate adjusted analysis (model 3) showed that the HRs in reference to married was 0.62 (95% CI: 0.19-2.03) for being widowed or divorced, and 1.10 (95% CI: 0.15-8.04) for being unmarried.

Table 4 shows the results of stratified analysis according to age (52 years old or less, over 52 years old), alcohol consumption (never drinking, former and current), smoking status (never smoking, former and current), body mass index (23 less, 23 or over), job status (employed, unemployed), education (high school or

less, college/university or higher), walking duration (at least 30 minutes per day, under 30 minutes per day), self-reported stress (high, average or low), and sleep duration (less than 7 hours per day, 7 hours per day or more). However, the results revealed that the risk of suicide was consistently higher for those who were widowed or divorced and tended to be higher for those who were unmarried, regardless of the status of each variable. We observed no significant interaction between marital status and other confounding factors for risk on an additive scale.

5. Discussions

The results of this population-based prospective cohort study of Japanese aged 40-64 years showed that marital status was significantly associated with the risk of completing suicide. Only in men, those who were widowed or divorced has a significantly higher risk of suicide than those who were married, and those who were unmarried tended to have an increased suicide risk.

Six previous studies have reported a positive association between marital status and the risk of suicide (three studies from the USA, one from Finland, one from Denmark, and one from Japan). In the USA, the three population-based studies revealed that being divorced was associated with an increased risk of suicide [6), 8), 11)], two of these studies found gender differences that divorced men had more risk of suicide than divorced women [8), 11)]. One of these three studies revealed that being unmarried carried a higher suicide risk than being married and found gender differences that men showed higher suicide risk than women under the same conditions[11)]. In the Finnish population-based study, it was

found that among working-age men living with someone other than a partner and among men living alone, suicide mortality was three times higher than among married men[10]. In addition, the Danish study based on three longitudinal registers revealed that older persons who were not married or cohabiting had a high mortality due to suicide, and concluded that being single was a significant risk factor for suicide in men[7]. Likewise, one study in Japan revealed that being widowed or divorced was a high risk factor[9]. Our present results reflected the findings of all these previous studies, especially for men. We assume that cultural backgrounds and differences in daily life roles between men and women may be responsible for the increased suicide risk among men who are widowed, divorced or unmarried.

On the basis of these previous studies and our present results, we think that suicide risk may be influenced by several factors. First, epidemiological studies have shown that divorced individuals tend to have psychiatric problems[17]. For many people, the loss of social support and family integration through divorce

is a stressful life crisis that may lead to severe psychological distress, which could place an individual at risk of suicide[18]. As clinical depression is often a prelude to suicide, poor mental health probably accounts for the higher risk of suicide observed among single people[19]. Secondly, the presence of a social network is a significant factor related to suicide risk, and the quality and strength of such networks may differ according to marital status. People who are married may be more integrated into a supportive social network than those who are not, and therefore they may not tend to live in isolation[20].

Our present study demonstrated a significantly increased risk of suicide death among men who were widowed or divorced, whereas women did not show such tendency. Several factors may contribute to this gender difference. The quality of a social network, i.e. whether it is deemed fulfilling or not, appears to differ between genders, and men's social networks are thought to be relatively fragile. It has been pointed out that men are not socially channeled toward nurturing others, and their intimate relationships tend to be less emotionally

oriented than those of women[21]. Compared with women, men tend not to discuss intimate topics with those who are close to them, nor do they seek help from people with whom they can talk about their concerns[22]. Men are less skilled at forming close relationships such as meaningful friendships at a higher level, and are less capable of psychologically benefitting from social networks. Accordingly, if a marriage ends in divorce or widowhood, a woman can fall back on her friendship network for emotional support, whereas a man find this much more difficult. Under these circumstances, men tend to lose meaningful supportive social networks that depend on family integration. A population-based prospective study conducted in Japan has shown that having four or more friends was significantly associated with a reduced risk of death from suicide in men[23]. Generally speaking, in Japanese culture, women have more responsibilities with housework such as child care, laundry, cooking and house-cleaning than do men[24]. Accordingly, Japanese women would tend to have stronger social relationships involving their family and have greater access to various types of social support

that would prevent them from committing suicide. The less meaningful social support for Japanese men can be explained by the fact that, culturally, they have tended to rely too much on their spouse for child care and housework, and have become preoccupied with their work, giving them fewer opportunities and less time to create meaningful social networks and to access social support. For these reasons, social networks available to widowed or divorced men are thought to be fragile, thus increasing their risk of suicide. These circumstances may play a significant role in accounting for the obvious difference in the rate of suicide between men and women.

In addition to this combination of factors and certain cultural considerations, the economic crisis of 1997-1998 in the Asian region cannot be ignored as a very important factor of that increased the incidence of suicide; at the same time, Japan faced its first rise in the unemployment rate[25]. It has been reported that low economic status is associated with a high risk of suicide[26]. In Japan, the annual salary of single-male households is smaller than the national

average, and divorced women tend to return to their parents' home to live[3]. This means that divorced men might feel less economic insecurity than divorced women. When all of the above factors are judged in combination with the social situation, it appears that men in Japan may be socially vulnerable and likely to have an increased risk of suicide resulting from deterioration of social networks, social support, and economic factors.

With regard to the relationship between suicide risk and gender from a Japanese standpoint, Japanese men face more severe emotional difficulties than women, and such difficulties seem to have much to do with the spirit of "self-sacrifice". This attitude is reflected in two types of abnormal death that almost invariably involve men: so-called "kodokusi" and "karoushi." "Kodokushi" is a type of isolation death thought to be caused by poor social networks. A major example of this is when elderly people live alone and do not desire contact with neighbors or locals, and furthermore may not ask for help even at the last minute[27]. In fact, more men die through "kodokushi" than from

different forms of suicide. Similarly having its origins in the spirit of self-sacrifice, “karoshi” - or death by overwork - is thought to be related to a lack of social support. Too much overwork can kill employees if their situation is combined with high demand, low control, and poor support[28), 29)]. Another troubling form of suicide known as “karo-jisatsu”, a variant of “karoshi,” is suicide carried out by an individual in order to escape the suffering imposed by excessive overwork (“jisatsu” means suicide in Japanese)[30)]. Therefore, deficient social support seems to explain why Japanese men become easily exposed to the risk of abnormal death.

The number of suicide in 2012 was less than 30,000 in Japan, and the number is decreased from 2011[31)]. We think as there are several factors to reduce the number of suicide. The local governments and private organizations have consolidated the system of a telephone or face-to-face counseling and implemented measures to guard against isolation. Cabinet Office has implemented efforts to cultivate human resources called “gatekeeper” capable of

picking up on the cue of isolation and suicide and taking the appropriate responses to it[32)] . Also, the Cabinet Office has run various workshops and training courses for private medical doctors, school personnel, health nurse, care manager, case worker, children's social worker, person in charge of the consultation service, and those who are related to this issue in all areas. As examples of the effort of the local governments, some areas in Yokohama City are working together cooperatively with utility companies, local public health check, and confirm household which needs support[33)] . They are trying to interfere with the household who does not use utilities such as electricity and gas for long period. Kitakyushu City is collaboration with Yakult group sales personnel[34)] . They make attempt to figure out those who with isolation signal on at-home sales and introduce them to appropriate consultation office. In general, as a countermeasure as isolation, there are increasing number of cases that each municipality constructs of a network with its own area and works in collaboration to private sector.

This study had several methodological advantages as compared with previous studies on the relationship between marital status and suicide risk. First of all, because of our procedure that yielded a high response rate of 90%, our data are fully representative of the study area. Secondly, the 18-year follow-up period was sufficient for clarifying outcomes. Thirdly, we extensively considered potential confounding variables, including socioeconomic, lifestyle, and psychological variables. We also attempted to conduct stratified analyses according to potential confounders.

On the other hand, our study also had some limitations. First, we had no information about other potential confounders, such as the prevalence of psychiatric disorders including depression. Although we might need to assume socioeconomic issues represent a critical problem for suicide, we had no information about socioeconomic factors such as family income and living arrangement. Secondly, our study subjects were restricted to the middle aged population, and thus did not represent a random sample of the Japanese

population. Suicide in the younger population was thus neither examined nor explained.

In conclusion, we have found that suicide risk is increased among Japanese men who are widowed or divorced. Our findings raise implications regarding the relationship between suicide risk and social bonds such as family integration and networking among the Japanese population. Our results seem to reflect the fact, culturally, Japanese men tend to perceive a spouse as being at the hub of social networks and support. Accordingly, marriage offers the best protection against suicide because it provides social and community integration, thus reducing social isolation. In order address this situation, it is essential to take measures focusing on men who are living alone, and strengthen their social networks and available support. This would help to decrease the rate of suicide death among Japanese men and contribute to the planning of effective suicide prevention programs.

6. Acknowledgments

We thank Yoshiko Nakata, Yumi Tamura, and Nayoko Aota for their technical assistance. The author would like to thank Prof. Ichiro Tsuji, Dr. Masako Kakizaki for their direction and advice throughout the study. I also wish to thank the members of Miyagi Disaster Mental Health Care center. Finally, I express my appreciation to the many families, teachers and friends who provided support.

7. References

1) World Health Organization: Suicide Prevention (SUPRE). Available at: http://www.who.int/mental_health/prevention/suicide/suicideprevent/en/ . Accessed March 20th, 2013

2) Vital statistics of Japan 2011. Health, Labour and Welfare Statistics Association, Tokyo, 2011

3) World Health Organization: Suicide Prevention. Country reports and charts. Available at: http://www.who.int/mental_health/prevention/suicide_rates/en/. Accessed March 20th, 2013

4) Chang SS, Gunnell D, Sterne J, Lu TH, Cheng A: Was the economic crisis 1997-1998 responsible for rising suicide rate in East/Southeast Asia? A time-trend analyses for Japan, Hong Kong, South Korea, Taiwan, Singapore and Thailand. Soc Sci Med 2009; 68: 1322-1331

5) Hirschfeld RM, Russell JM: Assessment and treatment of suicidal patients. N Engl J Med 1997; 337: 910-915

6) Ross RK, Bernstein L, Trent L, Henderson BE, Paganini-Hill A: A prospective study of risk factors for traumatic death in a retirement community. Prev med 1990; 19: 323-334

7) Qin P, Agerbo E, Westergard-Nielsen N, Eriksson T, Mortensen PB: Gender differences in risk factors for suicide in Denmark. Br J Psychiatry 2000; 177: 546-550

8) Kposowa AJ: Marital status and suicide in the National Longitudinal Mortality study. J Epidemiol Com Health 2000; 54: 254-261

9) Fujino Y, Mizoe T, Tokui N, Yoshimura N, Yoshimura T: Prospective cohort study of stress, life satisfaction, self-rated health, insomnia, and suicide death in Japan. Suicide Life Threat Behav 2005; 35: 227-237

10) Seppo K, Kaisla J, Tuija M, Pekka M: Mortality differences according to living arrangements. Int J Epidemiol 2007; 36: 1255-1264

11) Denney JT, Rogers RG, Krueger PM, Wadsworth T: Adult suicide mortality in the United States: marital status, family size, socioeconomic status, and

differences by sex. Soc sci Q 2009; 90: 1167-1185

12) Comprehensive Survey of Living Conditions. Health, Labour and Welfare Statistics Association, Tokyo, 2010

13) Fukao A, Tsubono Y, Komatsu S, Tsuji I, Minami Y, Hisamichi S, Hosokawa T, Kawamura M, Takano A, Sugahara N, Ikeda T, Nishikori N: A Cohort study on the relation of lifestyle, personality and biologic markers to cancer in Miyagi, Japan: Study design, response rate and profiles of the cohort subjects. J Epidemiol 1995; 5: 153-157

14) Tsuji I, Nishino Y, Tsubono Y, Suzuki Y, Hozawa A, Nakaya N, Fujita K, Kuriyama S, Shibuya D, Fukao A, Hisamichi S: Follow-up and mortality profiles in the Miyagi Cohort Study. J Epidemiol 2004; 14 Suppl 1: 2-6

15) Manual of the international statistical classification of diseases, injuries, and causes of death. 9th revision. World Health Organization, Geneva, 1977

16) International statistical classification of diseases and related health problems. 10th ed. World Health Organization, Geneva, 1992

17) Kreitman N: Suicide, age and marital status. Psychol Med 1988; 18: 121-128

18) Inoue K: Significant correlation of the change in the divorce rate with the suicide rate in Japan from 1992 to 2004. Am J Forensic Med Pathol 2009; 30, 311

19) Hassan R, 1995: Suicide explained. Melbourne University Press, Melbourne, 1995

20) Veerrers JE: Parenthood and suicide: An examination of a neglected variables. Soc Sci Med 1973; 7: 135-144

21) Bell D: Gender differences in the social moderators of stress. Free Press, New Yolk, 1987; 257-277

22) McFarlane AH, Neale KA, Norman GR, Roy RG, Streiner DL: Methodological issues in developing a scale to measure social support. Schizophrenia Bulletin 1981; 7: 90-100

23) Kalpana PT, Nanri A, Mizoe T, Matsushita Y, Takahashi Y, Noda M, Inoue M, Tsugane S: Social support and suicide in Japanese men and women-The Japan

Public Health Center (JPHC)-based prospective study. J Psychiatr Res 2011; 45: 1545-1550

24) The public opinion survey on a gender-equal society of Japan: Cabinet Office Japan, Gender Equality Bureau, Tokyo, 2012

25) Annual Report on the Labour Force Survey: Ministry of Internal Affairs and Communications Japan, Tokyo, 2011

26) Kposowa AJ, Breault KD, Singh GK: White male suicide in the United States: A multivariate Individual-Level analysis. Soc Forces 1995; 74: 315-325

27) Fukukawa Y: Solitary death: a new problem of an aging society in Japan. J Am Geriatr Soc 2011; 59: 174-175

28) Michie S, Cockcroft A: Overwork can kill. BMJ 1996; 312: 921-922

29) Iwasaki K, Takahashi M, Nakata A: Health problems due to long working hours in Japan: working hours, workers' compensation (Karoshi), and preventive measures. Ind Health 2006; 44: 537-540

30) Kondo N, Oh J: Suicide and karoshi (death from overwork) during the recent

economic crises in Japan: the impacts, mechanisms and political responses. J Epidemiol Com Health 2010; 64: 649-650

31) Vital statistics of Japan 2012. Health, Labour and Welfare Statistics Association, Tokyo, 2012

32) Cabinet Office of Japan. Suicide prevention. Available at: http://www8.cao.go.jp/jisatsutaisaku/index.html. Accessed June 20th, 2013

33) Health and Social Welfare Bureau of Yokohama city. Stopped isolation. Available at: http://www.city.yokohama.jp/ne/news/press/201212/20121214-025-15816.html. Accessed June 20th, 2013

34) Ministry of Health, Labour and Welfare. Stopped isolation strategy in the various regions. http://www.mhlw.go.jp/stf/shingi/2r9852000002dpfa-att/2r9852000002dpmf.pdf. Accessed June 20th, 2013

Table 1. Prospective cohort studies on the association between marital status and suicide risk

First author (year)	Setting	Follow-up periods	Number of sbjects	Number of suicidal deaths	Result and conclusion	
					marital status	Gender diffences
Ross RK (1990)	USA	1981–1986 (6 years)	11,888	19	↑ (widowed or divorced)	(–)
Qin P (2000)	Denmark	1982–1994 (13 years)	79,871	811	↑ (being single)	men > women
Kposowa A (2000)	USA	1979–1989 (11years)	471,922	545	↑ (divorced)	men > women
Fujino Y (2005)	Japan	1986–1999 (14 years)	13,259	48	↑ (widowed or divorced)	men > women
Seppo K (2007)	Finland	1996–2000 (5 years)	15.7 million person-years	undescribed	↑ (living alone)	(–)
Denny JT (2009)	USA	1986–2002 (17years)	1,055,943	1,275	↑ (widowed or separated, divorced, unmarried)	men > women

Abbrevations: ↑=increased risk; (–)=no association

Table 2. Characteristics of participants according to marital status

Characteristics	Marital status					
	Men			Women		
	Married	Widowed or divorced	Unmarried	Married	Widowed or divorced	Unmarried
No	19130	770	771	18380	2177	519
Age(years), means±SD	51.7 ±7.6	53.5 ±7.4	46.5 ±6.9	51.6 ±7.4	55.6 ±6.9	52.2 ±7.4
Alchol consumption						
Never	14.7	14.9	23.5	58.7	57.0	57.3
Former	7.2	8.8	8.0	3.1	5.0	4.3
Current (<45.6g alcohol/day)	40.7	39.1	38.3	19.5	19.9	19.3
Current (≧45.6g alcohol/day)	35.6	36.0	27.7	2.0	3.3	3.2
Smoking(%)						
Never	18.1	15.7	22.3	69.7	66.1	67.1
Former	20.3	16.2	13.9	1.5	2.6	2.7
Current (<20 cigarettes/day)	14.5	14.4	13.6	4.2	6.0	6.2
Current (≧20 cigarettes/day)	45.1	51.0	46.8	2.2	4.0	3.7
Body mass index, kg/m^2(SD)	23.6 (2.77)	23.3 (2.81)	23.3 (3.06)	23.7 (3.09)	23.8 (3.33)	23.0 (3.41)
Employment status						
Employed	88.2	80.7	78.6	55.2	54.9	55.7
Unemployed	4.9	8.3	12.6	34.1	33.7	32.6
Education(%)						
Until 15 years of age (Junior high school or less)	38.0	43.5	39.4	35.6	43.6	37.0
Until 16-18 years (High school)	43.2	38.3	41.1	46.4	39.6	39.5
Until 19 years or older (College/university or higher)	14.1	10.3	12.1	13.1	11.6	15.6
Walking duration						
At least 1 hour/day	42.0	41.4	39.0	41.7	39.5	38.2
Under 1 hour/day	52.0	51.4	53.6	50.5	51.6	53.4
Self-reported stress(%)						
High	21.8	20.0	19.3	21.3	20.1	20.6
Average	63.3	61.7	64.5	64.8	64.1	61.1
Low	14.1	17.0	15.1	12.9	15.0	16.6
Sleep duration(%)						
<7 hours/day	16.4	20.4	16.5	22.9	22.1	18.3
≧7 hours/day	81.6	77.0	79.3	74.7	74.6	77.8
Past histories(%)						
Stroke	1.0	2.0	0.7	0.5	0.9	1.0
Hypertension	18.6	24.0	11.2	19.5	26.5	19.9
Myocardial infarction	1.5	2.1	0.8	0.8	1.6	1.4
Diabetes mellitus	5.4	7.8	4.0	3.2	3.8	4.4
Cancer	0.6	0.1	0.8	1.7	2.1	2.7
Total caloric intake (kcal/d)	1974.6 (607.8)	1841.2 (629.6)	1902.3 (672.2)	1332.0 (350.7)	1278.1 (358.2)	1259.1 (396.3)

Table 3. Cox proportional hazard ratios (HRs) and 95% confidence intervals (95% CIs) of death from suicide according to marital status

	Marital status		
	Married	Widowed or divorced	Unmarriied
Men and Women (n=41,747)			
Person-years	640,497	48,568	21,273
No. of suicide	127	12	7
Model 1 (Crude HRs)	1.00 (ref)	1.26 (0.70-2.28)	1.67 (0.78-3.58)
Model 2 (Age-adjusted HRs)	1.00 (ref)	1.72 (0.94-3.15)	1.47 (0.68-3.16)
Model 3	1.00 (ref)	1.69 (0.92-3.09)	1.51 (0.70-3.27)
Model 4	1.00 (ref)	1.46 (0.73-2.90)	1.54 (0.72-3.30)
Men (n=20,671)			
Person-years	319,990	12,160	12,663
No. of suicide	91	9	6
Model 1 (Crude HRs)	1.00 (ref)	2.67 (1.35-5.29)	1.67 (0.73-3.82)
Model 2 (Age-adjusted HRs)	1.00 (ref)	2.80 (1.41-5.55)	1.46 (0.66-3.36)
Model 3	1.00 (ref)	2.86 (1.43-5.70)	1.57 (0.67-3.64)
Model 4	1.00 (ref)	2.84 (1.36-5.89)	1.56 (0.67-3.63)
Women (n=21,076)			
Person-years	320,506	36,408	8,610
No. of suicide	36	3	1
Model 1 (Crude HRs)	1.00 (ref)	0.74 (0.23-2.41)	1.05 (0.14-7.63)
Model 2 (Age-adjusted HRs)	1.00 (ref)	0.63 (0.19-2.05)	1.03 (0.14-7.50)
Model 3	1.00 (ref)	0.62 (0.19-2.03)	1.10 (0.15-8.04)
Model 4	1.00 (ref)	0.22 (0.03-1.65)	1.21 (0.16-8.96)

HRs were calculated by Cox proportional hazard regression analysis.
95% CIs in parentheses.
In model 3, multivariate HRs are adjusted for age (continuous varaibles), smoking (never smokers, ex-smokers, currently smoking), drinking (never drinkers, ex-drinkers, currently drinkers consuming <45.6g alcohol/day, currently drinkers consuming ≧45.6g alcohol/day), Body Mass Index in kg/m2 (<18.4, 18.5-24.9, >25.0), job (yes, no), education (high school or less, college/university or higher), time spent walking (<1h per day, >1h per day), self-reported stress(much, avarrage, little), sleep duration (<7h per day, >7h per day), past histories of stroke, hypertension, myocardial infarction, diabetes mellitus, cancer (presence or absence)、and total calorie intake (continuous variables).
In model 4, multivariate HRs with suicide death in the first 3-years of follow-up (6cases) excluded from analysis in the model.
There is no significant interaction between marital status and sex (P for interaction = 0.86).

Table 4. Multivariate HRs of suicide mortality according to marital status by potential confounders (n=41,747)

Characteristics	Marital status			P for interaction
	Married	Widowed or divorced	Unmarried	
Age classes				
<52 years (case=75)	1.00 (ref)	2.78 (1.19-6.49)	1.45 (0.57-3.66)	0.74
≧52years (case=71)	1.00 (ref)	1.12 (0.48-2.65)	1.45 (0.35-5.98)	
Alchol consumption				
Never (case=37)	1.00 (ref)	1.34 (0.46-3.89)	1.72 (0.40-7.40)	0.97
Former and current (case=99)	1.00 (ref)	2.04 (0.93-4.46)	1.49 (0.60-3.73)	
Smoking(%)				
Never (case=42)	1.00 (ref)	1.06 (0.37-3.04)	0.84 (0.11-6.23)	0.25
Former and current (case=95)	1.00 (ref)	2.65 (1.27-5.54)	1.77 (0.76-4.13)	
BMI in kg/m^2				
<23.0 (case=76)	1.00 (ref)	1.36 (0.54-3.43)	1.30 (0.47-3.62)	0.42
≧23.0 (case=70)	1.00 (ref)	1.89 (0.85-4.22)	1.76 (0.55-5.70)	
Employment status				
Employed (case=116)	1.00 (ref)	1.96 (0.98-3.93)	1.32 (0.53-3.28)	0.85
Unemployed (case=18)	1.00 (ref)	0.95 (0.21-4.32)	1.52 (0.17-13.84)	
Education(%)				
High school or less (case=120)	1.00 (ref)	1.88 (1.00-3.56)	1.40 (0.56-3.46)	0.97
College / university or higher (case=26)	1.00 (ref)	0.81 (0.11-6.10)	1.57 (0.34-7.16)	
Walking duration				
At least 30 min /day (case=97)	1.00 (ref)	1.98 (0.98-4.01)	0.69 (0.17-2.84)	0.10
Under 30 min /day (case=41)	1.00 (ref)	1.08 (0.26-4.58)	2.35 (0.80-6.91)	
Self-reported stress(%)				
High (case=45)	1.00 (ref)	1.88 (0.66-5.41)	0.70 (0.09-5.27)	0.54
Average or low (case=99)	1.00 (ref)	1.70 (0.81-3.56)	1.79 (0.77-4.16)	
Sleep duration(%)				
<7 hours/day (case=36)	1.00 (ref)	1.88 (0.65-5.48)	0.96 (0.13-7.20)	0.72
≧7 hours/day (case=106)	1.00 (ref)	1.71 (0.82-3.57)	1.78 (0.77-4.13)	

HR=Hazard ratio; BMI=Body Mass Index.

Multivariate HR are adjusted for age (continuous varaibles), smoking (never smokers, ex-smokers, currently smoking), drinking (never drinkers, ex-drinkers, currently drinkers), Body Mass Index in kg/m2 (<18.4, 18.5-24.9, >25.0), job (ye, no), education (high school or less, college/university or higher), time spent walking (<1h per day, >1h per day), self-reported stress(much, avarrage, little), sleep duration (<7h per day, >7h per day), past histories of stroke, hypertension, myocardial infarction, diabetes mellitus, cancer (presence or absence)、and total calorie intake (continuous variables).